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THE DEVELOPMENT OF A TECHNIQUE FOR MEASURING THE KNOWLEDGE AND PRACTICE OF MIDWIVES[1]

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Improvement in the care given women during the maternity cycle is, and has been for the past decade, an important objective of public health service. The procedures followed to obtain this objective have varied in the several sections of the country because of the differing conditions prevailing in the various localities. In the rural sections of the Southern States, one of the elements to which consideration must be given in effecting any progress in improving maternity and infant hygiene is the education and supervision of the Negro midwife, who at the time of delivery is frequently the sole attendant of a maternity case.

In many of the Southern States, public health authorities have realized the need for improving the midwifery service and have instituted programs with that objective in view; but the procedures incorporated in these programs are extremely varied in the several States as well as for the different counties within a given State. In some States the permits are granted to midwives solely on the basis of a local doctor's recommendation; in other States intensive group instruction is given at midwife classes before the midwives are given their permits, and then later nursing visits are made for supervisory purposes; in other States permits are granted without any previous instruction, and the only education and control of the midwife consists of frequent visits by the nurse, coupled with supervisory antepartum and post-partum visits with the midwife to her patients.

Certainly some of the many procedures now being practiced must be more effective than others. If it were known which ones yield the best results, then definite progress could be made toward improving

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In connection with this paper, the reader is referred to The Rural Midwife: Her Social and Economic Background and Her Practices as Observed in Brunswick County, Va., Pub. Health Rep., 50:1807-1815, (Dec. 27) 1935.

all programs for control of the midwife. The question then is: Which of the present existing procedures secures the best midwifery service with the minimum of public expenditure? The Office of Studies of Public Health Methods of the United States Public Health Service, long interested in evaluation studies of public health procedures, recently began a study of the problem for this very purpose of determining which procedures have been most effective in producing competent midwife service. Such an evaluation when completed may well be considered a sound basis for the construction of efficient programs for controlling midwives in the rural sections of the South.

METHOD OF EVALUATION

It is axiomatic that any procedure is effective to the extent that it produces results. For this evaluation of programs of midwifery supervision and control, it is assumed that communities in which midwives are practicing the procedures outlined in the manuals of midwifery practice issued by the respective State health departments have better control over their midwives than communities in which the midwives are not following accepted obstetrical practice. The aim will be to discover the methods of selection, instruction, supervision, and control of the midwives used in those counties that have capable midwives as opposed to the methods employed in those counties where the quality of the midwife practice leaves much to be desired.

The evaluation, then, may be conceived in terms of four distinct steps of procedure:

1. Construction and preliminary trial of a test for the measurement of a midwife's knowledge and practice.
2. Development of a means of discovering and recording all those administrative procedures of a health department concerned with the control and supervision of midwives.
3. With the techniques developed in steps 1 and 2, the measurement of a sampling of midwives in each of a number of communities, and the recording of the health departments' activities for those communities.
4. Relating the quality of service rendered by the midwives in each community to the type of midwife control used in that community, thus precipitating the methods of control that have been effective in producing a high quality of midwife service.

These steps are somewhat discrete procedures and must be taken consecutively in the order named. What follows herein is a report of the experimentation that was conducted in completing the first step of the project. It describes in detail the experimental derivation of a technique for measuring midwife information and practice.

THE NEED FOR AN INDEX

Records of the actual procedures followed by a midwife in her ante-partum, delivery, and post-partum care of a number of maternity cases would constitute an ideal measure of the quality of maternal service given by that particular midwife. From such records one could ascertain the extent to which the midwife was following the techniques prescribed in the midwifery manual.

To obtain unbiased observational records of midwives in their routine activities, however, is almost impossible. If they know that they are being observed, they are likely to omit certain things which they would otherwise do and follow more closely the prescribed procedures. Furthermore, the observation of each of a number of midwives for several maternity cases necessitates an unreasonable amount of time and expense. It is essential, therefore, to develop some other method that will give an index of the quality of care given by a midwife—in other words, some measure that will distinguish midwives who practice good techniques from those who follow poor and even bad practices. This index should reflect distinctions in the quality of service rendered by different midwives rather than attempt to measure directly the ability of each midwife to meet emergencies, or their understanding of the maternity cycle.

Any index that is devised must be objective; that is, the index must be of such a nature that the results obtained are not dependent upon the individual who uses the index. Midwives who register as superior midwives when this index is applied by one examiner should also register as superior if measured by some other examiner.

The index must also be representative of the actual information and conduct of the midwife. It must be shown to be indicative of the variations in the quality of service which the various individual midwives give. Those midwives who pay no attention to accepted methods of cleanliness and prescribe for their patients all sorts of home remedies, many of them based on superstitions, must register low on the index as compared with those midwives whose routine procedures conform to the pattern set forth in the midwife manual.

After careful consideration had been given to a number of possible methods of developing an index with these characteristics, the personal interview was selected as the method most likely to yield the desired results in the practical situation. Accordingly, an extensive form, containing some 66 objective standardized groups of questions on midwifery information and practice, was constructed. These questions were focused on the general subjects of equipment, prenatal care, complications of pregnancy, delivery care, complications of delivery, and post-partum care of both the mother and the baby.

Information was sought on both good and bad practices under each of these general headings.[2]

The questions were framed in a variety of ways in the attempt to elicit the truth. The fact that a midwife may know the correct procedure is no assurance that she follows that procedure. Insofar as possible, the questions were asked in terms of behavior rather than information. Often questions on the same practices were asked in more than one connection in the hope of arriving more nearly at the actual practice. For example, each of the following questions was asked in an attempt to identify those midwives who practice vaginal examinations:

Have any of your cases insisted that you make a vaginal examination? (If yes) What did you do? (If no) What would you do?

What can you find out from an internal examination?

Does it help you to make an internal examination?

Since the colored midwife is very susceptible to suggestion, many of the questions were stated negatively, thus causing her to defend the proper procedure. For example, note the following sample questions:

Do you remind the expectant mothers that they should eat enough for two people?

When you get water from a good deep well, do you bother to boil it? (If yes) Why?

The first drafted interview was subjected to a preliminary trial, and after a few slight revisions no further changes were made before the preliminary data were gathered.

EVIDENCE FOR THE INTERVIEW FORM

In the beginning of the study, advantage was taken of the fact that the Office of Child Hygiene Investigations had been conducting an intensive study of the midwives in a county in Virginia. The nurse who had been conducting that study was engaged to initiate and carry on the field work in connection with the development of the index. Midwives were interviewed by the nurse, using the objective interview form, in the county in which she had been working, as well as in two adjoining counties, one of which was in North Carolina.

The geography and population of the three counties are markedly similar. All 3 of the counties are strictly rural in that their largest town has a population of around 2,000. The Negro population slightly outnumbers the white, and midwives deliver approximately 60 percent of the total births in two of the counties and 25 percent

[2] A copy of the interview form (abbreviated) and the directions for administering and scoring are available in mimeographed form and may be obtained on request addressed to the Office of Studies of Public Health Methods, U. S. Public Health Service, Washington, D. C.

in the other county. Most of the midwives are Negro, past middle age, unable to read or write, and live on small farms more or less isolated from one another. Since transportation is difficult, they seldom visit outside their immediate neighborhood.

Concerning the supervision that has been given the midwives, there are wide differences among the counties. In county A, there had been no county health unit prior to January 1, 1935, and consequently the only supervision and education given had come from a nurse in the State health department. She made an annual supervisory visit to the county, but, because of her extensive territory, could not give intensive supervision (such as home visits, and demonstration ante-partum and post-partum home calls) to the midwives of any one of the several counties under her jurisdiction. In county B, supervision of midwives was begun in 1922 by the State health department. In 1924, when a full-time county nurse was employed, she assumed this responsibility. The program has been interrupted for short periods several times, but the supervision of the midwives of this county has been much more intensive than in county A. In county C, the midwives were under continuous intensive supervision from 1923 to 1932 by a nurse employed as the county public health nurse. She visited the midwives in their homes frequently, inspecting their equipment, accompanied them on calls to their patients, and demonstrated the prescribed techniques of ante-partum and post-partum care. Since 1932 the supervision has been under the State department of health. A State nurse holds annual classes, bag inspection, and issues the annual licenses.

In counties A and B the midwives are given a permanent license, but in county C only an annual license is issued. This latter procedure allows for more effective control, since the weeding out of the worst midwives from the group occurs annually.

To obtain data on the adequacy of the interview form, 20 midwives were interviewed in county A, 34 in county B, and 26 in county C, making a total of 80 midwives interviewed.

SCORING THE INTERVIEW FORMS

When the interviews had been completed, the responses to each question were given a numerical value and then the sum of these values for each midwife represented her score. The correct response to each question, with one or two exceptions, was given a score of one. For example, if the answer to the question, "What food other than breast milk do you give the baby?" was "Boiled water", the question was given a score of one. Such responses as "sugar bubby", "water with a pinch of soda and sugar" were scored zero. A minus

score of two was given if the midwife believed in such superstitions as "burnt feathers under the nose", "snuff in the face", or "eating raw red onion" as methods of hurrying up the birth of the baby.[3]

OBJECTIVITY AND RELIABILITY OF THE INTERVIEW FORM

It was impractical to determine, empirically, the objectivity of the interview form by having two interviewers question the same group of midwives and then compute the degree of agreement between results obtained by the two examiners independently. But the very nature of the questions, which were always asked in the same way, and the fact that the interviewer always recorded the total response given, argue the objectivity of the method.

A large number of questions were included to insure some representation of each of the many phases of midwife practice and knowledge. Of course, all possible questions were not asked, nor would it have been possible to ask questions about every phase of midwifery care; but proof that the questions included are representative of the quality of information and behavior peculiar to each midwife is furnished from an internal analysis of the data. By randomly dividing the entire battery of questions into two groupings and then scoring the two separate sets of questions, two scores were obtained for each midwife—one on each half of the material. A comparison of the relative standing of each midwife on one set of questions with her relative standing on the other set of questions indicates the accuracy of the distinctions made by the interview form. If the midwives who make relatively high scores on one-half of the questions also make relatively high scores on the other half, and if those who score low on one set also score low on the other set, then it can be assumed that the interview form contains an adequate number of questions, for the same distinctions are made between the midwives irrespective of which set of questions is used. Also it may be safely inferred from such analysis that the addition to the interview form of other questions of similar nature would not materially affect the distinctions between the midwives shown by the entire set of questions used. An index of the degree to which the same distinctions are made using the two halves of the material is afforded by the correlation between the two sets of scores (table 1).[4] The extent to

[3] Complete directions for scoring the form finally adopted are given in a mimeographed supplement to this paper and may be obtained, upon written request, from the Office of Investigations of Public Health Methods.

[4] The correlation was computed using the Pearson product moment formula:

$$r_{xy}=\frac{\Sigma xy}{N\sigma_x\sigma_y}$$

which the total material makes reliable distinctions between the midwives is shown in the last column of the table.[5]

The correlation of .95, representing the reliability of the entire battery of questions, indicates clearly that the interview form as constructed makes reliable distinctions between the midwives, and that the questions are representative of some common factor. Since all the questions are based on midwifery information and practice, it may be assumed that the common factor is quality of midwife service.

TABLE 1.—*Reliability of the midwife interview form (correlations between scores on one half of the interview form with scores on the other half of the interview form)*

Source of data	Number of cases	Correlations	
		One-half with one-half	Reliability of total material [1]
County A	20	.90	.95
County B	34	.90	.95
County C	26	.84	.91
Total	80	.90	.95

[1] See footnote 5, below.

VALIDITY OF THE METHOD

Is the assumption that this index is a measure of the quality of midwife service and of the knowledge which midwives have a valid assumption? Several types of data were used to prove the validity of the index. The first was a comparison of the midwives from the three counties. Since, by definition, the midwives in county A had had considerably less supervision than the midwives in county B, and those in county B had had somewhat less intensive supervision than those in county C, we would expect the midwives in county A to be inferior to the two other groups, and the midwives in county C to be slightly better than either group A or B. If the technique actually reveals differences in midwives that are produced by supervision, then the scores of the midwives in county A should be lower than the scores of the midwives of the other two counties.

It is evident from the distributions of the scores of the midwives in the three counties (table 2) that the scores in county A are not as high as the scores in the other two counties, and that the scores in county B tend to be lower than those in county C. In terms of

[5] The figures in this column represent the correlation that would be expected between the entire set of questions and another set of questions of equal number and reliability. They are obtained using Spearman's formula:

$$r_s = \frac{2r_h}{1+r_h}$$

where r_s is the reliability of the total test and r_h is the correlation between the scores on two halves of the test (Garrett, Henry E.: Statistics in Psychology and Education, Longmans, Green & Co., New York, 1926, p. 271).

average scores, there are about 22 points of difference between group A and group B, and the same amount of difference between group B and group C. In terms of median scores, the difference is even greater.[6] The distinctions between groups of midwives made by the interview form correspond with the differences that are known to exist. As a measure to distinguish extreme groups, the interview form is therefore valid.

TABLE 2.—*Distribution of scores on the midwife interview form for the 3 counties included in the study*

Midwife interview scores	Frequency of occurrence of each score in—		
	County A	County B	County C
150–159		2	2
140–149	1	2	8
130–139	1	3	5
120–129	1	5	3
110–119	1	3	3
100–109	1	5	1
90–99	1	5	2
80–89	2	4	2
70–79	3	4	
60–69	6		
50–59	3	1	
Total	20	34	26
Mean score [1]	84.2	106.4	128.0
Median	74	101	137

[1] These means were computed from the raw ungrouped data.

Ratings of the ability of the midwives in county B, made by the nurse who had had intimate contact with these midwives for a period of 7 months, served as the second criterion for the establishment of the validity of the interview form. The nurse who made the ratings had just completed an intensive study of these midwives, during which time she had talked with them in their homes, had watched the majority of them at both ante-partum and post-partum visits, and in three instances had observed the midwives during deliveries. The 34 midwives were independently rated on a scale of from 1 to 10, on 2 separate occasions. The correlation between the two sets of ratings is .94.[7] The correlations between each of the two ratings and the scores on the interview form are .84 and .86. Considering the unreliability of subjective ratings, these correlations indicate a fairly high degree of validity for the discriminations made by the interview form.

As previously suggested, the ideal criterion would be complete actual records of the kind of prenatal, delivery, and postnatal care which each midwife habitually gives. Observations of the mid-

[6] The difference between the means of group A and group B, and the difference between the means of group B and group C, are reliable differences. The standard deviation of the first difference is 7.6 and of the second difference is 5.9.

[7] One would ordinarily expect a correlation of unity between the 2 sets of ratings by the same person. The fact that the correlation is not unity is partial explanation for the lower correlations with the scores on the interview form.

wives, however, would not reveal this, for if the midwife knew the proper procedure, she would very likely follow it in the presence of the nurse, although she might behave in an entirely different manner were the nurse not present. Then, too, to obtain such observations is practically impossible in a rural community where distances are great and where facilities for communication are limited.

An attempt was made, therefore, to discover further the kind of care the individual midwives give by questioning the mother concerning the prenatal care and by questioning the attendant at the birth, other than the midwife, in regard to the delivery and post-partum care.

It was soon discovered that little or no prenatal advice was being given. Many of the cases did not engage the midwife in advance; and even when they did, the midwife seldom visited an expectant mother. Consequently, questions about what advice had been given by the midwife were often embarrassing to the mothers. In view of this difficulty, and since none of the midwives in county B, where it was possible to do this intensive investigation, gave anything like adequate prenatal service to their patients, the questions on ante-partum care were discontinued.

However, during the limited time of the preliminary experiment, information on delivery and post-partum care was obtained on a total of 56 mothers whose homes were visited by the field worker after the babies had been delivered by midwives from county B. Both the other attendant at the birth and the mother herself were questioned concerning the way in which the midwife prepared for and conducted the delivery, how she cared for the baby, and what intra-partum and post-partum care she gave the mother. It is, of course, difficult to judge the quality of a midwife on the reports of her activity as given by the patient or the attendant. In 17 of the 56 cases the midwife arrived after the baby had been born. For such cases, questions on preparation and the delivery did not apply. In six cases the doctor was called in either by the midwife or the family, and in these cases the delivery care and post-partum advice were given by the physician.

In many instances the mothers did not know whether the midwife had carefully washed her hands before delivering the baby, whether "drops" had been put in the baby's eyes, or whether many other of the accepted techniques had been followed. The difficulties in this type of material make direct evaluation impracticable unless a large number of post-partum reports can be obtained for each midwife. In the period covered by this study, it was impossible to secure more than 3 cases for any one midwife, and this number was possible for only 11 midwives. Two cases were obtained for each of nine midwives, and there was only one case for each of five others. The remaining mid-

wives in the group studied did not attend a birth during the study period.

Although the delivery and post-natal data are not sufficiently complete to serve as a criterion for a direct validation of the midwife interview form, there are a few distinct differences in score on the midwife interview that are associated with specific practices revealed by the post-partum interview. For example, midwives who had scores of 130 or above (the average score for the 25 midwives for which post-partum interviews were obtained was 112) made an average of 4.3 return post-partum visits, whereas those who made scores of 100 or below made only 1.9 post-partum visits. Midwives who make high scores on the midwife interview tend to give more continued post-partum care than midwives who make low scores. A number of other comparisons are given below which indicate that the midwives who are reported as following accepted techniques make slightly higher scores than those who did not follow prescribed practices.

The average score for the 15 midwives who did nothing to speed up the birth of the baby was 116; for the 6 who either gave quinine, or camphor in hot water, or parched eggshell tea, or greased "privates" (the perineum), the average score was 103.

The mothers interviewed were sure that nine of the midwives used either a sterile cloth or a special dressing on the cord. The average score for these 9 was 119. The average for the 15 who used cotton, a scorched rag, or a clean rag was 108.

The evidence was fairly conclusive that three of the midwives did not wash their hands more than once during the delivery. Their average score was 94, as opposed to an average of 117 for the 19 who were reported to have washed their hands a number of times.

The mothers attended by seven of the midwives reported that they were advised to bathe their breasts and nipples frequently in boric water to prevent soreness. The average score for these 7 midwives was 129, while for the 14 who either gave no advice at all or advised greasing with lard, camphorated oil, or mutton suet and sage, the average score was 105.

Vaginal examinations were performed by nine of the midwives according to the statements of the patients they attended. The average score for these 9 was 110, as compared with 114 for the 13 midwives who were reported as not performing vaginal examinations.

Fifteen midwives made sure that the mother was bathed before the baby was born. Their average score was 119. This is considerably higher than the average score of 103 for the seven who did not take this precaution.

The 18 midwives who advised their patients to bathe the field with lysol water each time after the pads were changed had an average

score of 118, whereas the 6 who did not advise this hygienic precaution scored only 92.

The differences between the averages are slight and, because of the small number of midwives included in each sample, are not statistically significant. However, the fact that in every case the acceptable practice is associated with the higher score indicates that the interview technique does distinguish the more competent midwives from those who are ignorant, untrained, and followers of superstition.

ABBREVIATION OF THE INTERVIEW FORM

As previously stated, the experimental interview form contained a large number of questions to insure a wide representation of the elements of midwifery knowledge and practice. In the field the interviewer found it long and tedious to administer. It required from an hour to 2 hours to interview one midwife. Oftentimes the midwife became bored and restless, thereby increasing the difficulty of completing the interview.

If the form were to be practical for extensive use the number of questions included needed to be reduced in order to eliminate the fatigue of both the interviewer and the person interviewed, and to increase the number of interviews that could be conducted during the day.

The primary basis for eliminating questions was the diagnostic significance of the separate questions. The diagnostic significance of an item depends upon two factors: (*a*) The frequency with which the question is answered correctly, and (*b*) the degree to which the item distinguishes the good midwives from the incompetent. Certainly a question which 90 percent or more of the midwives answer correctly cannot be very valuable as an item that distinguishes good midwives, for the responses given by the good midwives do not differ from the responses given by those lacking ability. For instance, all but five of the midwives mentioned "slapping the back", "hot and cold water baths", or "artificial respiration" as methods for starting the baby to breathe. Since practically all the midwives, good and poor, knew at least one of these acceptable methods, this question was eliminated. Likewise, all questions that were answered incorrectly by over 90 percent of the midwives were excluded.[8] Of the 219 items originally included, 27 were excluded on this criterion.

Furthermore, an item to be truly discerning must be answered correctly more frequently by the good midwives than by the poor ones. It has already been shown (in the previous section) that those midwives who make high scores on the total interview form

[8] This criterion for exclusion should not be taken to mean that the information or activity covered by a question which over 90 percent fail is unimportant, but rather that the question is not useful in making distinctions between the midwives.

perform a better quality of service than those who make low scores; therefore, the value of any item may be judged by separating the midwives into two groups, according to the way in which they answer the item, and comparing the total scores (scores obtained on all the questions) of those midwives who answer the particular item correctly with the total score of those who answer incorrectly. If a correct reply is more often associated with a high total score, and an incorrect reply more frequently accompanies a low total score, then that item or question may be considered of value, for it distinguishes good midwives from poor ones. Take the following question: "Do any of your cases ever engage you in advance? Does it make any difference whether they do or not? What?" In response to this question, 27 midwives stated that they urged their cases to engage them early in order that they might discover danger signs or the need for a doctor. The average score for these 27 midwives was 135, whereas the 53 who did not mention this reason for early engagement averaged only 94. Moreover, very few of the midwives who answer the question incorrectly make higher scores than those who answer the item correctly, and vice versa, as may be seen in the first two histograms in figure 1. This question is therefore highly diagnostic, for the midwives who answer it correctly make much higher scores than those who do not answer it correctly.

Contrast with the above the results on the following question: "What kinds of food should an expecting [9] mother eat?" Cereal was mentioned by 29 midwives. Their average total score was 110. The average score of the 51 who failed to mention cereal as desirable food was 107. The difference is negligible. The histograms showing the distribution of scores for these two groups are almost identical. The question is useless in distinguishing the good and poor midwives, and was excluded from the final test.

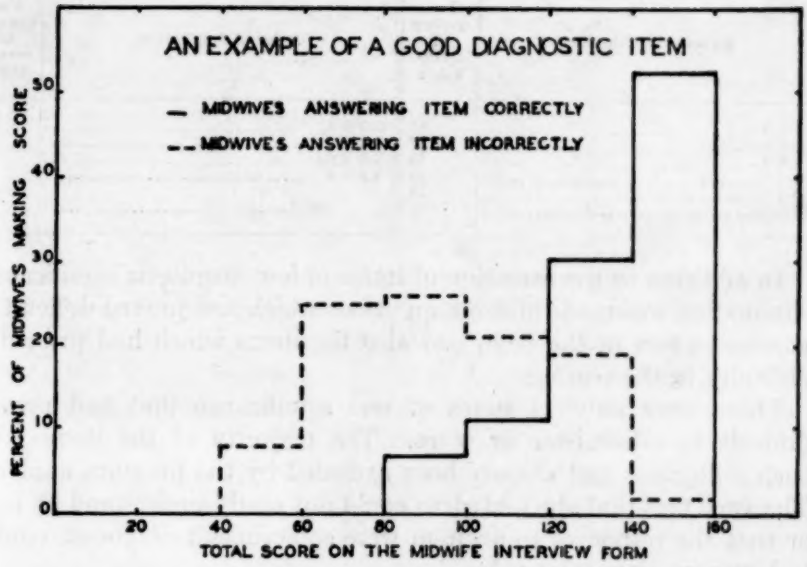
Each of the remaining 192 items was subjected to this type of analysis. To take into account both the overlapping of scores and the difference between the mean scores of the midwives who answered an item correctly and those who answered it incorrectly, an index of the significance of each item was computed.[10] A distribution of

[9] The correct term here is "expectant", but the midwives use "expecting", and the questions are stated as nearly as possible in their "language." Many other expressions in the interview form were stated in terms used by the midwives without regard to their grammatical accuracy.

[10] The significance of each item is the relation of the difference between the mean scores of the midwives in the two categories (those who answered the item correctly and those who failed the item) to the standard deviation of that difference. The formula is:

$$\textit{Index of significance} = \frac{M_1 - M_2}{\sqrt{\sigma^2_{M1} + \sigma^2_{M2}}},$$

where M_1 is the average score of the midwives that responded to the item correctly, σ_{M1} is the variability of M_1; M_2 and σ_{M2} are similar constants for the distribution of scores for those midwives who answer the item incorrectly.



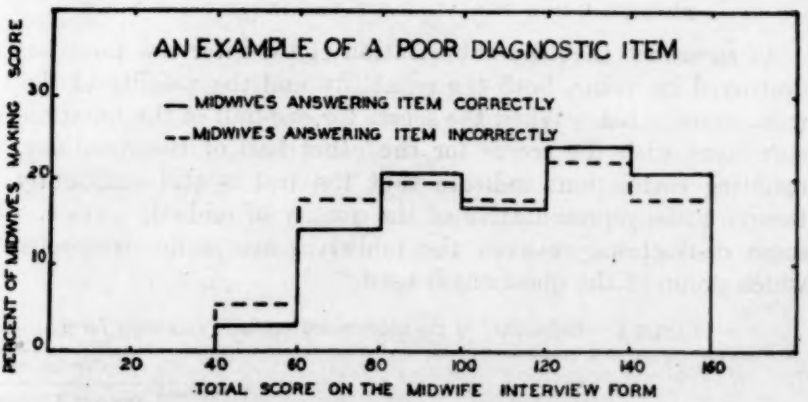


FIGURE 1.—Distribution of scores on the midwife interview form for (1) midwives who answer an item correctly and (2) midwives who answer the item incorrectly.

these indices of significance is given in table 3. In the final selection of items only the items with significance of 3.0 or more were retained.

TABLE 3.—*Distribution of the indices of significance for all the items in the midwife interview form*

Index of significance	Frequency of occurrence	Index of significance	Frequency of occurrence
0-0.9	17	6.0-6.9	26
1.0-1.9	17	7.0-7.9	7
2.0-2.9	18	8.0-8.9	9
3.0-3.9	29	9.0-9.9	3
4.0-4.9	39		
5.0-5.9	27	Total	192

In addition to the exclusion of items of low diagnostic significance, elimination was made of those questions which had proved difficult of administration in the field, and also the items which had presented difficulty in the scoring.

There were only 14 items of real significance that had proved difficult to administer or score. The majority of the items with such difficulties had already been excluded by the previous analysis. The very fact that the midwives could not easily understand an item or that the responses to an item were sometimes ambiguous, tended to lower its diagnostic value.

As a result of the 3 types of exclusions just described, the original 219 items were reduced to 126, which can be grouped into 41 questions.

EVIDENCE FOR THE ABBREVIATED INTERVIEW FORM

As assurance that the abbreviation of the interview form has not destroyed its value, both the reliability and the validity of the test were recomputed. When the scores for one-half of the questions are correlated with the scores for the other half of the questions, the resulting correlations indicate that the test is still sufficiently extensive to be representative of the quality of midwife service. The same distinctions between the midwives are made irrespective of which group of the questions is used.

TABLE 4.—*Reliability of the abbreviated midwife interview form*

Source of data	Number of cases	Correlations	
		One half with one half	Reliability of total material [1]
County A	20	.93	.96
County B	34	.88	.94
County C	26	[2] .77	.87
Total	80	.90	.95

[1] Obtained by using the Spearman correction formula; see footnote 5, p. 763.

[2] The scores for the midwives in this county are much more homogeneous than the scores for the midwives in the other 2 counties. The reliability of the test is lowered by the low standard deviation. The standard deviation of the scores for counties A and B is 10, and for county C is 8.

The average score on the abbreviated form for the midwives in county A was 50.4; in county B, 65; and in county C, 85. A comparison of the differences between these averages with those obtained using the original form shows that the same distinctions between the counties have been preserved in abbreviating the interview form.

The correlations of the two sets of ratings by the nurse with the scores on the abbreviated test in county B were .83 and .85. These correspond favorably with the previous correlations of .84 and .86. It is safe to say that abbreviating the test has not lessened its value as a measure of the quality of midwife service.

SUMMARY

From a large battery of questions on midwifery practice and information, an interview form has been constructed as an index of the quality of service a midwife renders when she attends a maternity case. The technique has been shown to be a reliable and valid measure of the service given by an individual midwife. Therefore, the degree of success or failure of any given program of midwifery control can be judged using this interview form.

In addition to its usefulness as a method of evaluating public health effort, the technique will serve to select the better midwives. Nurses in their supervisory programs can interview the midwives in their community and determine those who need the most supervision and teaching. Midwives who score extremely low can be eliminated by taking away their permits. Others with high scores need not be checked so often. The supervisory time will thus be focused on those midwives needing the most help, who may reasonably be expected to profit therefrom.

The interview form was developed as the first step in the evaluation study of various public health procedures used in the control of the midwife in the Southern States. Future studies contemplate completing the evaluation by carrying out the three remaining steps described in the beginning of this paper. A technique for registering the administrative procedures followed by health departments for the education, supervision, and control of midwives will be constructed. Utilizing this technique, the health department practice for a number of counties in which the modes of midwife control are different will be recorded, and a number of midwives in each of these counties will also be measured using the midwife-interview form. From the relationships between these two sets of data it will be possible to determine which procedures are effective in producing a high quality of midwife service. Programs of midwifery control can then be constructed to include procedures of tested effectiveness.

THE ANEMIA OF DEAMINIZED CASEIN

By M. I. Smith, *Principal Pharmacologist*, and E. F. Stohlman, *Junior Pharmacologist, Division of Pharmacology, National Institute of Health, United States Public Health Service*

In 1904, Levites (1), and in 1906, Skraup and Hoernes (2) prepared and examined the deaminized product obtained by treating casein with nitrous acid. In 1921, Dunn and Lewis (3) extended these observations and described an improved method for the preparation of deaminized casein. These authors also studied the nitrogen distribution in deaminized casein as compared with casein and found, in addition to the nearly complete disappearance of free amino nitrogen, diminution of tyrosine and histidine and complete absence of lysine.

Aside from the disappearance of free amino nitrogen, the precise chemical change taking place in the protein molecule through deaminization with nitrous acid is not known. Lewis and Updegraff (4) consider the variable loss of tyrosine to be a secondary reaction, dependent upon the time and temperature of the reaction. Analysis of deaminized casein for tryptophane and arginine by Wiley and Lewis (5) revealed no significant change, while about half of the histidine was found to be destroyed. White (6) found no change in the cystine content of deaminized casein. The formation of diazo derivatives were suspected by Treves and Salomone (7), and the possibility of formation of nitroso compounds was suggested by Dunn and Lewis (3).

The biological and nutritional properties of deaminized casein have also been examined. Digestion of deaminized casein *in vitro* with pepsin and trypsin was found by Dunn and Lewis (8) not to differ materially from that of casein. Steudel (9) fed deaminized casein to rats at a 20 percent level and observed an immediate decline in weight. The nutritive failure was not corrected by lysine supplements.

Of particular interest and great significance is the recent report by Hogan and Ritchie (10), who found that when rats were fed a diet containing deaminized casein they developed anemia. Gelatin and gliadin supplements, individually or in combination to compensate for the known amino acid deficiencies of deaminized casein, failed to protect. This led them to suspect a toxic factor, against which, they argued, was their observation that casein added in equal amount with the deaminized casein prevented the anemia. On the basis of these observations they were unwilling to commit themselves definitely, either in favor of a deficiency or in favor of a toxic factor, and were forced to assume that either casein contains some group which overcomes the toxic action of deaminized casein, or that it contains some nutrient which is normally required, but is needed in greater amount when deaminized casein is included in the diet.

We undertook to examine this type of experimental anemia chiefly for its biologic and morphologic characteristics. In the course of this work certain observations were made which, in the main, confirm the work of Hogan and Ritchie. We believe, however, that we have secured conclusive evidence showing that the deaminized casein anemia is an intoxication and not a deficiency disease, though the precise nature of the toxic factor still remains to be determined.

EXPERIMENTAL

The deaminized casein was prepared according to the method of Dunn and Lewis (3). The albino rats used in these experiments were from an inbred colony on a stock diet of yellow corn, whole wheat, oats, bread and milk, and some lettuce fed twice a week. Blood counts, reticulocyte counts,[1] hemoglobin determinations,[2] and Wright's blood films were studied from time to time.

The composition of the experimental rations of special interest in connection with this work is outlined in table 1. In some of the diets a vitamin B_1B_2 concentrate obtained from brewers' yeast with an activity for B_1 and B_2 of from 50 to 100 times that of dried brewers' yeast was used.[3] In the others, dried brewers' yeast was used as a source of vitamins of the B group. Salt mixture 185 of McCollum and Simmonds (12) supplied the inorganic constituents, and cod liver oil furnished vitamins A and D.

TABLE 1.—*Composition of experimental rations*

Ration	1	2	3	4	5	6	7	8	9	10	11
Deaminized casein	10	10	10	10	10	10					
Deaminized casein extracted with CH_3OH-NaOH							10		10	10	
Deaminized casein extracted with CH_3OH-HCl								10			
Reprecipitated deaminized casein											10
Casein					5	15				15	15
Lysine, tyrosine, histidine		2									
B_1B_2 concentrate	0.2	0.2					0.2	0.2			
Dried brewers' yeast			5	12	5	5			12	5	5
Salt mixture 185	4	4	4	4	4	4	4	4	4	4	4
Cod liver oil	2	2	2	2	2	2	2	2	2	2	2
Olive oil	8	8	8	8	8	8	8	8	8	8	8
Corn starch	76	74	71	64	66	56	76	76	64	56	56

FEATURES OF THE ANEMIA

The features and progress of the anemia will be best described as it occurs in rats on a diet in which deaminized casein is the only source of protein (ration 1, table 1). After a latent interval of about 10 to 15 days, during which time blood examination reveals little or nothing of an unusual character, there begin to appear anisocytosis, a moderate degree of reticulocytosis, and a considerable number of large, usually polychromasic cells frequently containing one or more

[1] Method of Osgood and Wilhelm (11).

[2] Newcomer hemoglobinometer.

[3] The preparation and properties of this concentrate will be described in another publication.

Howell-Jollie bodies. The occurrence of polychromasic macrocytes with Howell-Jollie bodies, frequently before there is a definitely discernible degree of anemia judged by red cell counts and hemoglobin determinations, is such a constant and characteristic feature that we believe one can recognize and distinguish this type of anemia even in its early stages by a simple examination of a Wright-stained blood film. As the disease progresses, the anemia becomes more pronounced, the red cell count may fall to as low as 2 million or less and the hemoglobin to as low as 20 percent.[4] Frequently, however, animals die before the anemia reaches a severe stage.

The chief morphologic characteristic of this anemia in its more advanced forms is that it presents a great variety of abnormal cellular elements. There are poikilocytes, microcytes, macrocytes, polychromasic cells, erythroblasts of all sizes, frequently with irregularly shaped and fragmented nuclei, and numerous Howell-Jollie bodies varying in size up to that of a small nucleus. The reticulocyte count rises from the normal, which is usually less than 1 percent, to about 5 to 10 percent, with another rise to as high as 25 percent just before death. Immature forms of white blood cells, such as myelocytes and myeloblasts also occur in variable numbers. Many of the features of this anemia, such as the color index and the morphologic characteristics, indicate a macrocytic and usually hyperchromic anemia not unlike that of pernicious anemia. Table 2 gives a detailed account of the progress of this anemia in a series of rats on ration 1. The weight curve of these rats is shown in figure 4. Figures 1 to 3 illustrate its morphologic characteristics.

TABLE 2.—*Experimental anemia of deaminized casein (ration 1)*

Rat number	Days on ration	RBC	Hb	Reticulocytes
			Percent	*Percent*
233	11	7.20	48	1
	15	4.18	37	25
241	11	4.35	35	2
	17	3.12	33	5
	21	1.92	23	25
240	12	7.76	57	1
	17	2.40	20	5
242	12	6.24	53	1
	18	2.00	20	5
	22	1.99	20	21
259	17	9.04	73	3
	28	4.44	33	3
260	22	5.98	45	12
261	28	7.14	55	2
	40	4.40	47	19
262	29	2.88	30	9

[4] The normal blood of the rat contains about 16 million red cells per cubic millimeter, 80 to 100 percent hemoglobin, and less than 1 percent reticulocytes.

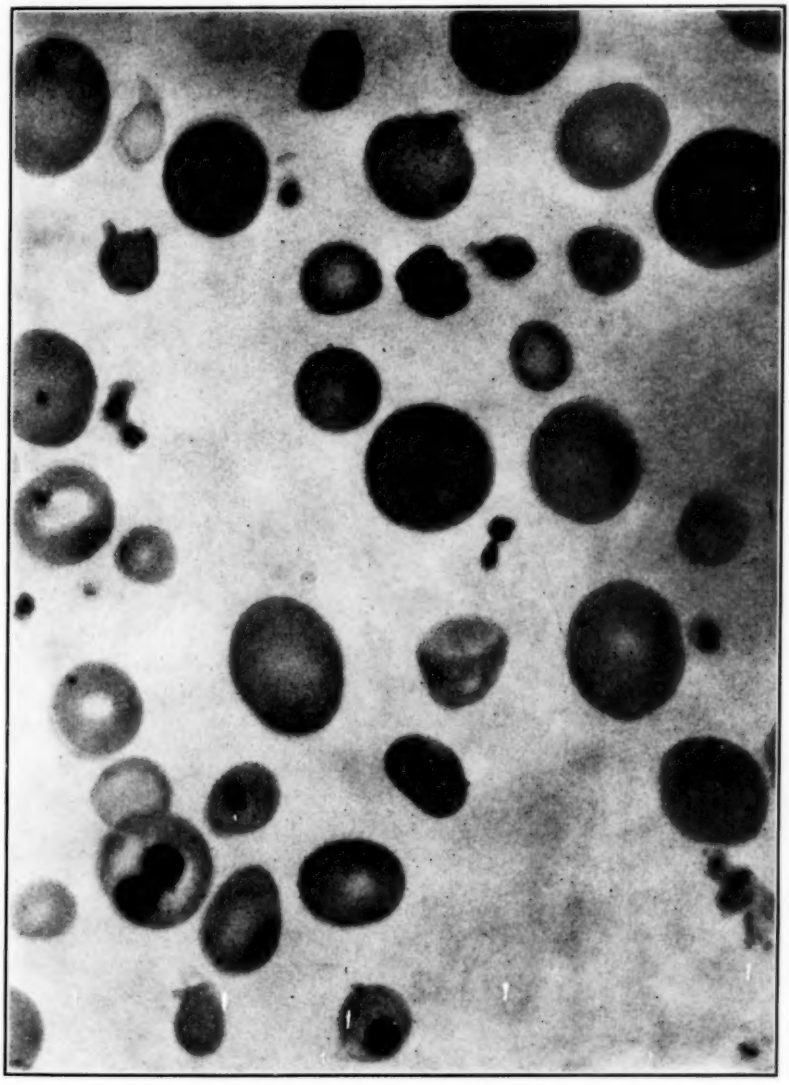


FIGURE 1.—Blood film of rat no. 233, 15 days on ration 1. Wright's stain; × 2,000.

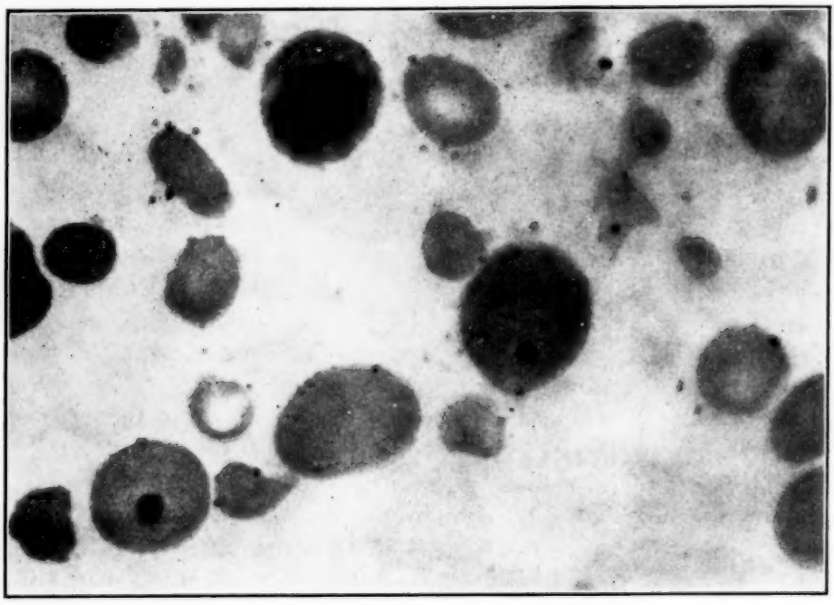


FIGURE 2.—Another view of the blood film shown in fig. 1, showing megaloblasts, megalocytes, and multiple Howell-Jollie bodies.

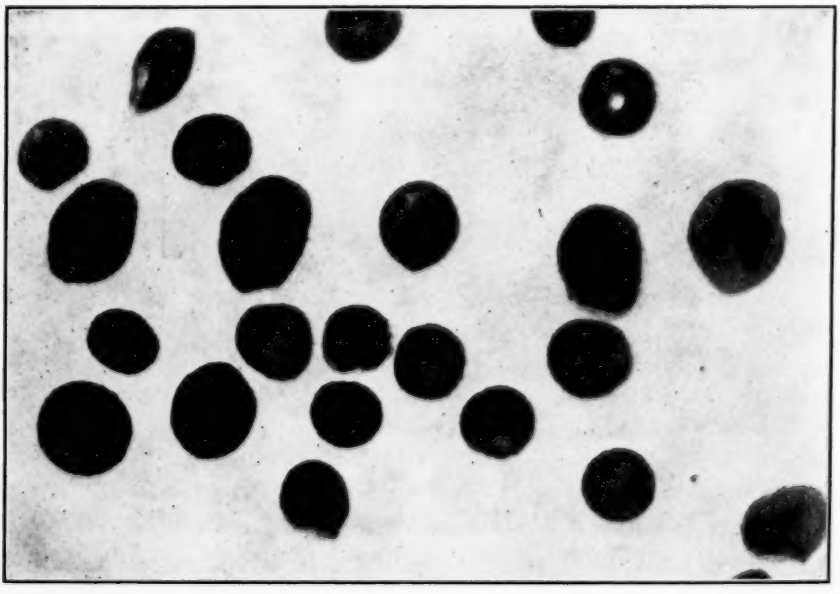


FIGURE 3.—Blood film of rat no. 260, 22 days on ration 1. Reticulocyte stain; × 2,000.

Histologic examination of the abdominal and thoracic organs of several animals of this group made by Passed Assistant Surgeon J. G. Pasternack, of the National Institute of Health, revealed but little of an abnormal character. The bone marrow of these animals presented the appearance of slight hyperplasia, with evidence of moderately active erythropoiesis.

THE INFLUENCE OF SUPPLEMENTS

In the next series of experiments it was planned to determine whether supplementing the deaminized casein would have any effect upon the blood picture. In view of the fact that deaminized casein is known to be wholly lacking in lysine and partially deficient in tyrosine and histidine (3, 4, 5), a group of experiments was carried out in which these amino acids were added in amounts approximately equivalent to those present in casein when fed at the optimum level of 18 percent. Six rats were fed such a diet (ration 2, table 1). Three rats of this group died in 20 to 26 days, and the 3 that survived a somewhat longer period showed the characteristic anemia, though perhaps somewhat less severe than that of the former group. Inspection of table 3 and figure 4 clearly shows that the amino acids known to be lacking in deaminized casein neither afford any protection against the anemia nor improve its nutritive properties.

TABLE 3.—*Effect of lysine, tyrosine, and histidine supplements on the anemia of deaminized casein (ration 2)*

Rat number	Days on ration	RBC	Hb	Reticulocytes	Remarks
			Percent	*Percent*	
292	28	6.41	60	4	Died. Macrocytic anemia.
293	21				Died. Blood smear showed typical anemia.
294	20				Died.
295	26				Died
327	29	6.68	65	9	Typical macrocytic anemia.
329	21	4.26	40	8	Do.

In the succeeding four groups the deaminized casein was supplemented, respectively, with 5-percent dried brewers' yeast; 12-percent dried brewers' yeast; 5-percent casein and 5-percent dried brewers' yeast; and, lastly, with 15-percent casein and 5-percent dried brewers' yeast (rations 3, 4, 5, and 6). The results of these experiments are shown in table 4, indicating definitely that in no instance were any of the animals completely protected against the anemia. The results do seem to indicate, however, that on the more adequate diets, i. e., diets containing liberal protein other than the deaminized casein, the red blood cells and hemoglobin did not fall so rapidly nor to as low

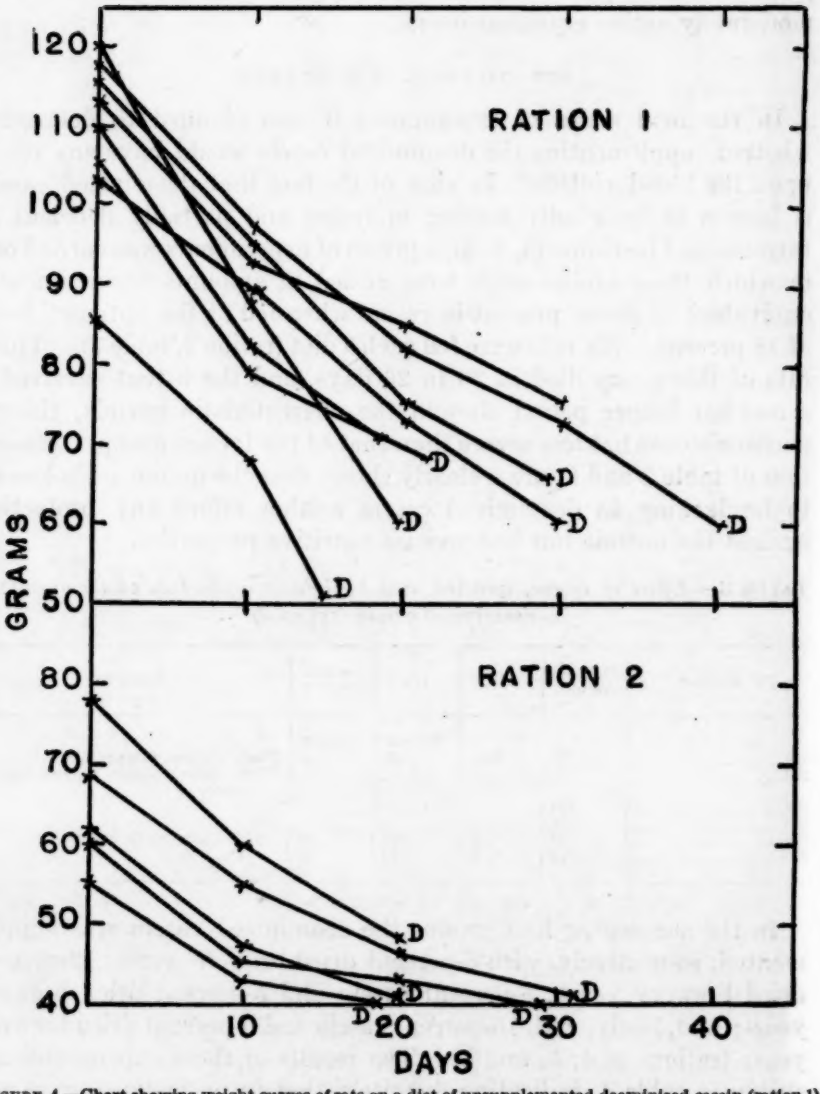


FIGURE 4.—Chart showing weight curves of rats on a diet of unsupplemented deaminized casein (ration 1) and on a diet supplemented with lysine, tyrosine, and histidine (ration 2).

a level as they did in the less adequately supplemented diets. It should be emphasized, however, that in no instance was the blood picture morphologically normal, even in the most adequately supplemented diets such as ration 6. Neither was the weight curve much better in the supplemented diets. (See figure 5.)

In one group of experiments (ration 4) the animals were taken off the anemia-producing diet after the anemia had fully developed and were placed on a normal adequate synthetic diet consisting of 18-percent casein, vitamins, salts, etc. (diet 242). Out of a group of

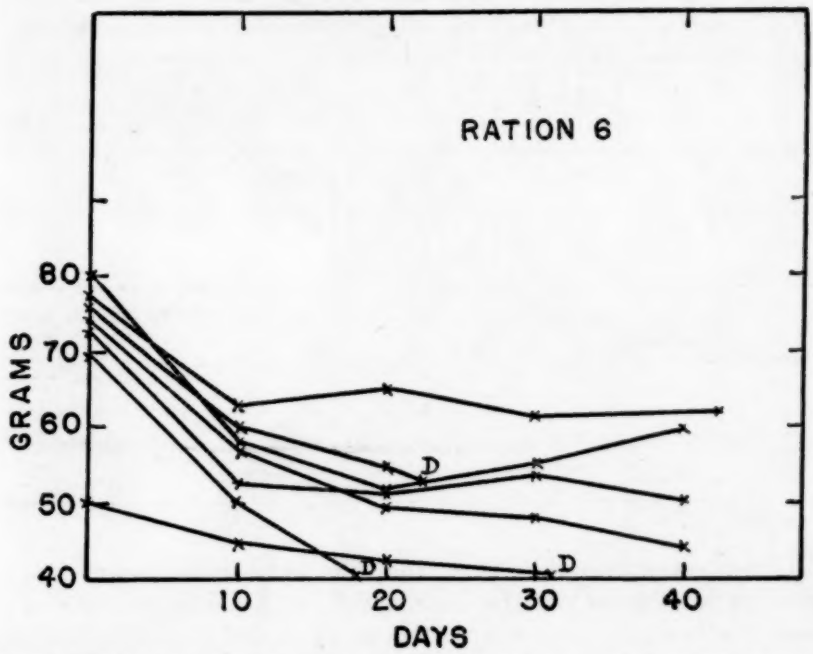


FIGURE 5.—Weight curves of rats on a diet of 10 percent deaminized casein supplemented with 15 percent casein.

six such rats, four showed good regeneration of red cells and hemoglobin, while two failed to recover and finally died.

We have also attempted to ascertain the response of this type of anemia to parenteral injection of liver extract. In a group of seven anemic rats, two on ration 1 and five on ration 5, liver extract [5] was injected intraperitoneally or intravenously daily in doses varying from 0.1 to 2.0 cc per kilo, over a period of from 3 to 8 days. No favorable effect was noted either on the reticulocytes or on the general blood picture. Indeed the treatment appeared to have no influence even in arresting the progress of the anemia.

[5] Eli Lilly Co.

TABLE 4.—*Effect of yeast and casein supplements on the anemia of deaminized casein*

Ration	Rat number	Days on ration	RBC	Hb	Reticulocytes	Remarks
				Per cent	*Per cent*	
3	1	21	------	20	--------	Died.
5-percent dried brewers' yeast.	2	22	2.18	20	--------	Chloroformed.
	3	22	2.84	23	--------	Do.
	4	22	------	------	--------	Died. Blood smear showed typically severe anemia.
4	248	24	2.56	35	3	Recovered in 2 weeks on diet 242.[1]
12-percent dried brewers' yeast.	250	24	5.33	57	2	Died while on ration 242.
	251	25	3.22	35	4	Recovered in 25 days on ration 242.
	254	25	8.03	80	2	Died while on ration 242.
	256	26	4.89	60	6	Recovered in 18 days on ration 242.
	257	23	3.84	45	6	Partial recovery in 16 days on ration 242.
5	279	44	6.46	60	1	
5-percent casein, and 5-percent dried brewers' yeast.	280	45	7.90	58	3	
	281	41	6.72	62	1	
	282	45	6.70	67	2	
	283	41	4.48	40	5	
6	1	24	------	------	--------	Died. Blood smear showed typically severe anemia.
15-percent casein, and 5-percent dried brewers' yeast.	2	29	6.80	72	4	Died.
	3	45	6.56	76	2	Characteristic anemia.
	4	17	7.00	64	1	Died. Blood smear showed typically moderate anemia.
	5	27	8.12	83	1	Anisocytosis, polychromatophilia, and few Howell-Jollie bodies.
	6	42	8.48	85	1	Anisocytosis, polychromatophilia, and Howell-Jollie bodies.
	7	40	7.20	82	5	Typical anemia.

[1] See text.

Our observations thus show that the same pathological process goes on whether or not the deaminized casein is supplemented with biologically adequate protein. Our experiments do indicate, however, that animals on a diet containing adequate protein in addition to deaminized casein seem to resist better the destructive effects of deaminized casein on the blood, possibly by permitting regeneration of new cells and hemoglobin, which might be less effective on a diet of inadequate protein. The nutritive failure of deaminized casein as judged by the weight curves and period of survival is not greatly improved by supplements of adequate protein. We believe that these results are susceptible of the following interpretation: First, the nutritive value of deaminized casein is low or nil; second, deaminized casein appears to contain an unidentified toxic factor highly specific for the blood elements. In view of the fact that a diet of deaminized casein, even if supplemented with adequate protein, is

frequently lethal in rats often before the blood shows profound changes, it seems probable that there may be still another toxic factor in deaminized casein, perhaps less specific than the one affecting the hematopoietic system. Obviously such a conclusion requires more direct proof. We therefore sought further evidence for this assumption in two directions: In the first place, we attempted to detoxify deaminized casein, and, second, we sought to prepare extracts of deaminized casein which, when injected parenterally into rats, would reproduce the characteristic blood picture just described.

THE DETOXIFICATION OF DEAMINIZED CASEIN

Various attempts at removal of the hypothetical toxic factor led to the observation that extraction of deaminized casein with methyl alcohol made alkaline with sodium hydroxide left a residue which, when fed to rats, no longer produced the anemia, or, if it did, it was of a very much milder form. As a result of many trials the most effective procedure appears to be the following: Suspend 25 gm of deaminized casein in about 400 cc CH_3OH containing 6 to 7 cc 9N NaOH (approximately 0.15 N NaOH in methyl alcohol) in an Erlenmyer flask and reflux on the water bath at 72°–75° C. 1 to 2 hours. Filter on a Buchner funnel and wash with CH_3OH till the reaction is neutral to litmus, then with ether and dry. This procedure removes not more than about 10 percent of the solids of deaminized casein.

Several groups of experiments were made with the foregoing residue fed at a level of 10 percent. In one group this constituted the only source of protein (ration 7, table 1). The rats in this group survived only from 19 to 28 days, clearly indicating that the protein was wholly inadequate. No evidence of anemia, however, was found in any of these animals. By way of control, a group of rats fed the residue of deaminized casein similarly extracted with 0.5 N HCl in CH_3OH (ration 8, table 1) showed the typical anemia within the survival period of 24 to 35 days.

In the succeeding experiment it was obviously necessary to include a source of protein other than deaminized casein. Two groups of experiments were therefore performed, one in which approximately 5 percent of yeast protein was included in the form of 12 percent dried brewers' yeast (ration 9), and the other in which 15 percent casein was included (ration 10), in addition to the "detoxified" deaminized casein. We have found from previous experience that a ration with 12 percent dried brewers' yeast as the only source of protein is a satisfactory maintenance diet, permitting even a slight degree of growth in the majority of young rats.

TABLE 5.—*Experiments showing the effect of feeding deaminized casein extracted by boiling with* CH_3OH–NaOH *(ration 10)*

Rat number	Days on ration	RBC	Hb	Reticulocytes	Remarks
			Percent	*Percent*	
1	34	9.60	100	[1] ±	Morphologically negative.
2	32	9.63	88	±	Do.
3	33	9.14	88	±	Do.
4	33	9.90	90	±	Do.
5	36	9.98	84	±	Do.
6	36	8.18	78	±	Slight degree of anisocytosis and occasional Howell-Jollie body.
7	36	10.74	85	±	Morphologically negative.

[1] A fraction of 1 percent.

The results of these experiments are shown in table 5. All but one of seven rats on ration 10 presented a normal blood picture in from 32 to 36 days. Only one of the rats, no. 6, had a red cell count and hemoglobin slightly below normal. Morphologically the blood picture of this animal showed an occasional Howell-Jollie body and a slight degree of anisocytosis. The growth curve of the animals of this group, which may be seen in figure 6, indicates a very fair state of nutrition. The animals on ration 9, however, developed a moderate degree of anemia. These results seem to prove conclusively that the anemia-producing and growth-inhibiting factor or factors of deaminized casein are to a large extent removed or destroyed by boiling with alkaline methyl alcohol.

In an attempt to ascertain whether the detoxication was due to the removal or the destruction of the toxic factor or factors, the extracts were distilled *in vacuo*, and the residue was taken up in a small volume of water, neutralized with HCl, and dried on starch, which was then incorporated into a ration containing 12 percent dried brewers' yeast as the only source of protein for the first 3 weeks, and 6 percent the following 3 weeks. The extract was fed at a level corresponding to 10 percent deaminized casein. Two rats were kept on this diet, which furnished only the minimum amount of protein compatible with life and optimum conditions for the production of the experimental anemia. At the end of the experimental period the two rats presented a normal blood picture, with the red cell count 9.04 and 10.07 million per cubic millimeter, and hemoglobin 80 percent and 90 percent, respectively. Blood smears showed none of the characteristic features of the anemia. It may be concluded from this experiment that the hematoxic factor in the deaminized casein had not been extracted, but was largely destroyed by boiling with alkaline methyl alcohol.

Further evidence of the inactivation of the anemia-producing factor in deaminized casein by treatment with alkali was obtained in an experiment in which reprecipitated deaminized casein was fed to a

group of rats, and the solution in which the dissolved casein had been reprecipitated was concentrated to small volume and injected intraperitoneally in another group of rats with the result that neither developed the anemia.

This experiment was performed as follows: 50 grams of deaminized casein were gradually dissolved in the course of 3 days at room temperature in about 2 liters of approximately 0.15 N aqueous

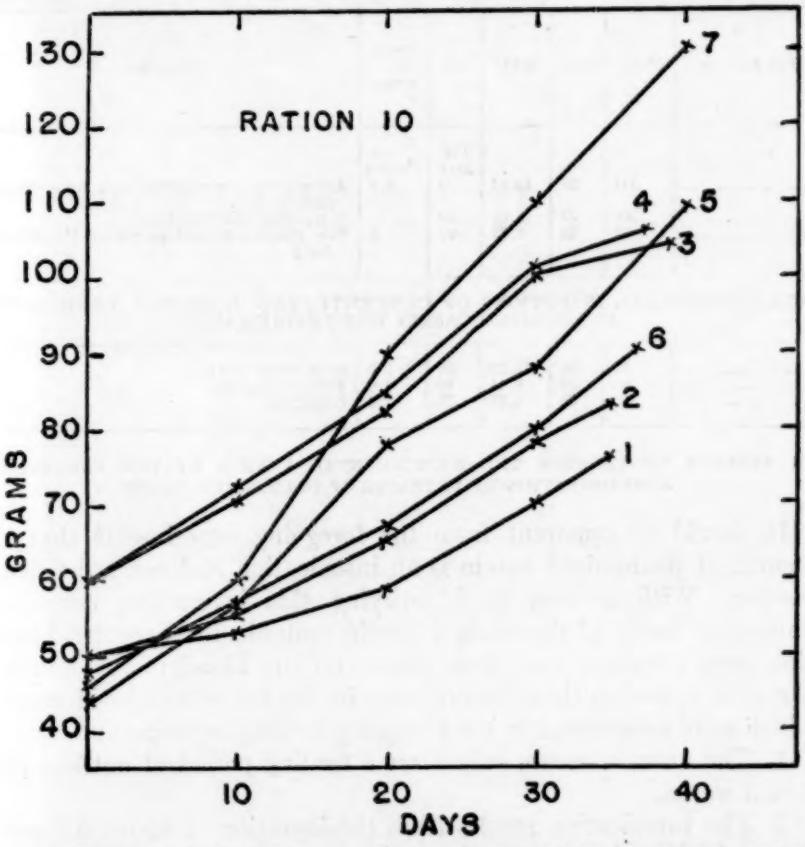


FIGURE 6.—Weight curves of rats on a diet containing 10 percent "detoxified" deaminized casein and 15 percent casein.

NaOH. The protein was then completely precipitated by the addition of about 300 cc N HCl. The precipitate was filtered off, washed, air dried, and incorporated in ration 11 (table 1). The solution was neutralized with NaOH to pH 6.4 and concentrated on the water bath so that each cubic centimeter represented the equivalent of 0.2 gm of deaminized casein, and this was injected daily intraperitoneally in a group of rats subsisting on a ration in which the only source of protein was 8 percent to 10 percent dried brewers' yeast. The results

of this experiment, shown in table 6, indicate that neither the reprecipitated casein nor the extract therefrom contained the anemia-producing factor in any appreciable amount. The weight curve of the animals on ration 11 is shown in figure 7.

TABLE 6.—*Effect of reprecipitation of deaminized casein on the anemia producing factor*

FEEDING OF REPRECIPITATED DEAMINIZED CASEIN (RATION 11)

Rat number	Grams	Days	RBC	Hb	Reticulocytes	Remarks
				Per cent	*Percent*	
1	124	38	10.14	80	0.3	Anisocytosis, macrocytes and some Howell-Jollie bodies.
2	100	37	8.02	92	-------	Morphologically negative.
3	92	30	8.72	90	.5	Few macrocytes and occasional Howell-Jollie body.
INTRAPERITONEAL INJECTIONS OF CONCENTRATED SOLUTION FROM WHICH DEAMINIZED CASEIN WAS PRECIPITATED						
1	86	37	10.22	70	3.0	Some anisocytosis.
2	96	37	9.44	80	1.0	Few macrocytes.
3	60	36	8.27	78	.5	Negative.

AN ATTEMPT TO PRODUCE THE EXPERIMENTAL ANEMIA BY THE PARENTERAL ADMINISTRATION OF EXTRACTS OF DEAMINIZED CASEIN

It should be apparent from the foregoing experiments that the anemia of deaminized casein is an intoxication and not a deficiency disease. With a view to identifying this interesting substance, various extracts of deaminized casein suitable for parenteral injection were prepared and their effects on the blood picture studied. We were guided in these experiments by the following considerations, which were established in the foregoing feeding experiments:

1. The anemia occurs only after a feeding period of not less than 2 to 3 weeks.

2. The intoxication results from the ingestion of about 0.5 gm of deaminized casein per day; hence it was aimed insofar as possible to have its equivalent per cc of extract as a suitable dose for injection.

3. The optimum ration for demonstrating the blood changes of deaminized casein is one containing a minimum of protein of good quality. The extracts were therefore injected intraperitoneally into young rats of 60–80 grams kept on a ration containing 8 percent dried brewers' yeast as the only source of protein.

4. Since alkali appears to have a destructive effect upon the unidentified anemia-producing factor, only neutral or acid extractions were attempted.

It would not be profitable to go into a detailed discussion of the various experiments carried out in an attempt to obtain an active extract. Suffice it to say that we have found no way of recovering the toxic factor short of relatively drastic hydrolysis of the deaminized casein with hydrochloric acid. Aqueous and alcoholic extracts made by refluxing deaminized casein with the solvents and subsequent concentration proved entirely inactive. An extract prepared by mild partial hydrolysis of deaminized casein with 20

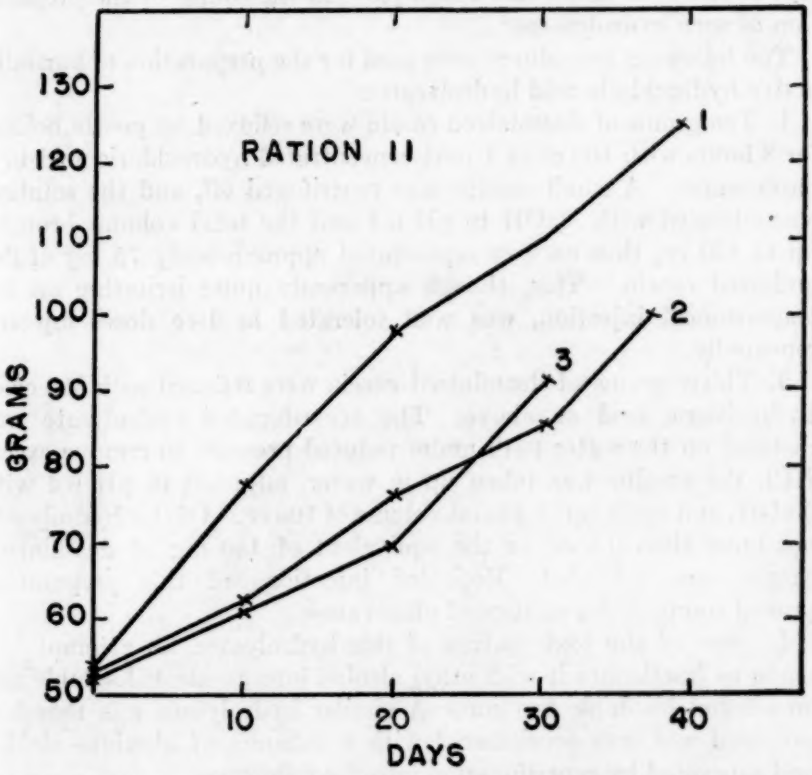


FIGURE 7.—Weight curves of rats on a diet containing 10 percent reprecipitated deaminized casein and 15 percent casein.

volumes 0.1 N aqueous hydrochloric acid by refluxing for 1 hour, subsequently neutralized and concentrated to represent the equivalent of 0.2 gm of deaminized casein per cc showed only some anisocytosis, and polychromasia after daily intraperitoneal injections of 1 cc over a period of 40 days.[6] The red cell count and hemoglobin remained normal throughout. The residual deaminized casein was fed to rats and it produced the anemia in the usual manner. This would seem to indicate that the toxic factor is so firmly bound to the protein

[6] Actually this extract contained only about 20 mg per cc for not more than 10 percent of the solids of deaminized casein had been removed by this procedure.

molecule that it could not be liberated without the more or less complete disintegration of the protein.

The daily intraperitoneal injection of a nearly complete hydrochloric acid hydrolysate of deaminized casein gave us definitely positive results, though not as uniformly as might be wished. Lack of uniformity, we believe, is due to the fact that such hydrolysates proved considerably toxic, and we were limited to relatively small doses. It is also quite possible, if not probable, that some destruction of the toxic factor had taken place in the course of the preparation of such hydrolysates.[7]

The following procedures were used for the preparation of partially active hydrochloric acid hydrolysates:

1. Ten grams of deaminized casein were refluxed by gentle boiling for 3 hours with 100 cc of 1 part concentrated hydrochloric acid to 5 parts water. A small residue was centrifuged off, and the solution was adjusted with NaOH to pH 6.4 and the total volume brought up to 130 cc; thus each cc represented approximately 75 mg of deaminized casein. This, though apparently quite irritating on intraperitoneal injection, was well tolerated in 1-cc doses injected repeatedly.

2. Thirty grams of deaminized casein were refluxed with 300 cc of hydrochloric acid as above. The centrifugated hydrolysate was distilled on the water bath under reduced pressure to remove excess HCl, the residue was taken up in water, adjusted to pH 6.4 with NaOH, and made up to a total volume of 100 cc. Of this hydrolysate not more than 0.5 cc, or the equivalent of 150 mg of deaminized casein, was tolerated. Repeated injections of this preparation proved too toxic for continued observation.

In view of the toxic nature of this hydrolysate, an attempt was made to fractionate it with ethyl alcohol into an alcohol soluble and an alcohol insoluble fraction. A similar hydrolysate was therefore prepared and was precipitated with 8 volumes of absolute alcohol and separated by centrifugation into the following:

2A. The clear alcoholic solution was evaporated on the water bath and the residue dissolved in a volume of water to represent the equivalent of 0.3 gm of deaminized casein per cc. This solution, in general, presented the same acute toxicity characteristics as did the preceding hydrolysate, though it was tolerated in doses up to 0.8 to 1.0 cc injected repeatedly.

[7] A sulphuric acid hydrolysate injected daily intraperitoneally in 1-cc doses containing the equivalent of 0.4 gm deaminized casein was without effect on the blood picture of rats after 30 such injections. It also appeared to be wholly free from any toxic effects. This hydrolysate was made by gently refluxing deaminized casein with 5 volumes of 25 percent H_2SO_4 for 3 hours. After centrifuging off a small amount of undigested material, the excess sulphuric acid was removed with powdered $Ba(OH)_2$ and the pH of the solution adjusted with NaOH to about 6.6, and finally the solution was concentrated on the water bath. It would seem that the toxic factor was either destroyed or possibly lost in the Ba precipitate.

2B. The alcohol insoluble precipitate was freed *in vacuo* of all traces of alcohol and the residue dissolved in water to represent the equivalent of 0.3 gm of deaminized casein per cc. This material was free from any acute toxic effects and was well tolerated in 1-cc doses.

TABLE 7.—*Effect of intraperitoneal injections of hydrolysates of deaminized casein*

Hydrolysate number	Rat number	Grams	Injections	Equivalent of deaminized casein	RBC	Hb	Reticulocytes	Wright's blood film
				Mg		*Per cent*	*Per cent*	
1	1	64	26	75	6.20	65	2	Typically moderate macrocytic anemia, numerous Howell-Jollie bodies.
	2	56	31	75	9.36	72	.5	Negative.
	3	90	33	75	7.96	80	2	Anisocytosis, macrocytes, polychromasia, few Howell-Jollie bodies.
2A	1	64	20	240	7.81	80	------	Anisocytosis, polychromasia, numerous macrocytes, Howell-Jollie bodies, and nucleated red cells. Died.
	2	60	20	240	8.54	84	2	Anisocytosis, myeloblasts, and macrocytes. Died.
	3	64	26	240	7.73	62	------	Anisocytosis, some macrocytes, and few Howell-Jollie bodies. Died.
	4	64	29	240	6.27	66	2	Anisocytosis, macrocytes, myeloblasts, and occasional Howell-Jollie bodies. Died.
	5	64	34	240	7.96	70	8	Do.
	6	72	13	240	7.53	75	4	Anisocytosis, macrocytes, polychromasia, myeloblasts, and few Howell-Jollie bodies and macroblasts.
	7	61	13	240	7.15	72	8	Do.
	8	66	24	240	6.70	58	6	Anisocytosis, polychromasia, macrocytes.
2B	1	84	19	300	4.30	35	4	Anisocytosis, polychromasia, some macrocytes, nucleated red cells, and few Howell-Jollie bodies.
	2	48	26	300	6.98	60	------	Anisocytosis, polychromasia, myeloblasts, and some macrocytes.
	3	70	32	300	8.48	67	2	Anisocytosis, macrocytes, few Howell-Jollie bodies.
	4	70	33	300	8.16	64	3	Anisocytosis, polychromasia, and some macrocytes.
	5	62	21	300	6.41	55	1	Anisocytosis. Died.

The results of the tests with these three preparations are shown in table 7. Though for the most part no more than a very moderate degree of anemia could be produced at best, as judged by the red cell count and hemoglobin determinations, nevertheless the very definite morphologic changes in the blood picture of the majority of the animals leads us to believe that this furnishes direct conclusive evidence of the toxic nature of the anemia of deaminized casein. It seems almost certain that had it been possible to administer the toxic factor in higher concentration, a more uniformly severer anemia would have been produced.

Regarding the chemical properties of the toxic factor, but little can be said. It seems certain that it is unstable in alkali. Partial or even complete destruction in strong acid seems likely. Its solubility in ethyl alcohol is indicated from the experiments 2A and 2B, detailed in

table 7; for, though both fractions produced anemia, the alcohol soluble fraction gave the more decisively characteristic blood picture of deaminized casein.

CONCLUSIONS

Deaminized casein has little, if any, nutritional value in the nutrition of the white rat.

When fed at a level of 10 percent, deaminized casein produces in the white rat a characteristic macrocytic megaloblastic anemia with many Howell-Jollie bodies. The inclusion of good quality protein does not prevent the pathological process, though it mitigates the severity of the anemia.

Boiling deaminized casein with alcoholic sodium hydroxide, or reprecipitation of deaminized casein from aqueous alkaline solution, destroys the anemia-producing factor to a considerable extent.

The intraperitoneal injection of the alcohol soluble fraction of a hydrochloric acid hydrolysate of deaminized casein reproduced the anemia sufficiently definitely to prove conclusively that the anemia is an intoxication and not a deficiency disease.

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NEW METHOD OF DETERMINING PLAGUE INFECTION IN RODENTS

A method of determining plague infection among wild rodents, based on mass inoculation, which holds promise of being of considerable practical value, has been reported by Surg. C. R. Eskey, in charge of the United States Public Health Service plague laboratory in San Francisco. Surgeon Eskey makes the following interesting report and comment on the procedure:

The fleas taken from ground squirrels shot in Elko County, Nev., on May 7 were placed in a small vial containing normal salt solution and sent to the laboratory in San Francisco. They arrived on May 11 and were then placed in clean salt solution in a mortar, ground up into an emulsion, and inoculated subcutaneously into a guinea pig. The guinea pig was found dead on the fifth day, and, upon autopsy,

presented the typical macroscopic pathology of plague. The microscopic examination of smears revealed large numbers of typical bipolar staining coccobacilli. A second guinea pig inoculated cutaneously died on the tenth day, and also presented the findings of plague infection. The cultures obtained from the first guinea pig were those of *Pasteurella pestis*.

The method used in discovering plague in this instance promises to be a valuable means of locating plague among wild rodents. It is comparable to the use of mass inoculation of animal tissue, but it is believed that even better results can be obtained with fleas. When only one piece of animal tissue used in mass inoculation is plague-infected, it is so diluted by the mixture of uninfected tissue that no organisms may be present in the portion used for inoculation, whereas in the case of fleas, if only one is infected it will be injected into the guinea pig, as all of the fleas are used. Plague cannot exist among rodents without the infection being present in the fleas they harbor; and, therefore, when the disease is present, the use of fleas for locating infection appears logical. Neither mass inoculation nor inspection of animals for suspicious lesions of plague will reveal the infection during the incubation period or in the early stages of infection when the infected fleas might be collected from the animals. When ground squirrels are obtained by shooting them, very few infected animals are ever found except in areas where a very virulent epizootic is occurring at the time when the animals are obtained.

DEATHS DURING WEEK ENDED MAY 23, 1936

[From the Weekly Health Index, issued by the Bureau of the Census, Department of Commerce]

	Week ended May 23, 1936	Corresponding week, 1935
Data from 86 large cities of the United States:		
Total deaths	8,387	8,351
Deaths per 1,000 population, annual basis	11.7	11.6
Deaths under 1 year of age	589	531
Deaths under 1 year of age per 1,000 estimated live births	53	49
Deaths per 1,000 population, annual basis, first 21 weeks of year	13.4	12.5
Data from industrial insurance companies:		
Policies in force	68,290,456	67,771,202
Number of death claims	13,588	13,094
Death claims per 1,000 policies in force, annual rate	10.4	10.1
Death claims per 1,000 policies, first 21 weeks of year, annual rate	10.8	10.7

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

CURRENT WEEKLY STATE REPORTS

These reports are preliminary, and the figures are subject to change when later returns are received by the State health officers

Reports for Weeks Ended May 30, 1936, and June 1, 1935

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended May 30, 1936, and June 1, 1935

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended May 30, 1936	Week ended June 1, 1935	Week ended May 30, 1936	Week ended June 1, 1935	Week ended May 30, 1936	Week ended June 1, 1935	Week ended May 30, 1936	Week ended June 1, 1935
New England States:								
Maine	2	4	2	----	315	280	1	0
New Hampshire	----	1	----	----	8	----	1	0
Vermont	----	----	----	----	183	14	0	0
Massachusetts	5	9	----	----	1,125	376	7	3
Rhode Island	3	----	----	3	40	452	2	2
Connecticut	2	7	1	----	203	592	0	0
Middle Atlantic States:								
New York	45	28	[1] 12	[1] 4	2,430	2,475	6	23
New Jersey	9	11	4	9	376	1,931	3	6
Pennsylvania	30	18	----	----	1,560	2,168	12	9
East North Central States:								
Ohio	27	32	22	62	608	2,038	6	14
Indiana	7	24	14	9	15	215	3	0
Illinois [2]	33	42	27	15	21	1,413	5	16
Michigan	4	7	2	3	75	2,648	4	2
Wisconsin	1	5	24	36	209	1,481	2	0
West North Central States:								
Minnesota	7	10	----	2	419	279	1	0
Iowa	2	11	----	----	5	204	0	0
Missouri	5	20	36	37	14	333	2	8
North Dakota	----	----	5	4	1	47	1	0
South Dakota	3	4	----	1	----	24	0	0
Nebraska	2	19	5	1	64	343	0	1
Kansas	4	3	----	----	5	545	0	3
South Atlantic States:								
Delaware	----	2	----	----	17	10	0	0
Maryland [3]	6	3	4	1	366	74	4	0
District of Columbia	9	13	----	1	148	28	0	6
Virginia	10	10	50	----	72	380	10	2
West Virginia	5	9	35	11	48	305	8	3
North Carolina	11	7	3	2	41	74	4	3
South Carolina	2	3	73	88	65	1	1	1
Georgia [4]	3	1	----	----	----	----	4	0
Florida	----	4	4	1	18	20	6	0

See footnotes at end of table.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended May 30, 1936, and June 1, 1935—Continued

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended May 30, 1936	Week ended June 1, 1935	Week ended May 30, 1936	Week ended June 1, 1935	Week ended May 30, 1936	Week ended June 1, 1935	Week ended May 30, 1936	Week ended June 1, 1935
East South Central States:								
Kentucky	3	3	2	5	23	105	32	5
Tennessee	8	4	32	8	35	41	5	3
Alabama [4]	12	10	43	18	3	103	3	0
Mississippi [3]	6	5	----	----	----	----	0	2
West South Central States:								
Arkansas	2	5	54	28	4	81	0	1
Louisiana	3	15	6	4	32	38	1	1
Oklahoma [5]	8	11	33	31	8	49	0	1
Texas [4]	30	32	100	45	280	53	8	3
Mountain States:								
Montana [2]	----	----	----	44	8	282	1	1
Idaho [2]	----	----	----	----	16	8	1	0
Wyoming [2]	----	----	----	----	1	23	0	1
Colorado [2]	5	13	----	----	44	506	0	0
New Mexico	2	6	6	9	68	14	0	3
Arizona	----	2	37	6	111	53	1	4
Utah [2 3]	----	----	----	----	19	2	0	0
Pacific States:								
Washington	----	1	9	----	339	461	0	1
Oregon [2]	1	----	11	15	102	215	1	4
California	36	21	82	27	1,567	1,281	2	7
Total	353	435	738	530	11,111	22,065	148	139
First 22 weeks of year	11,692	13,910	136,520	100,639	218,257	598,436	5,020	3,134

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended May 30, 1936	Week ended June 1, 1935	Week ended May 30, 1936	Week ended June 1, 1935	Week ended May 30, 1936	Week ended June 1, 1935	Week ended May 30, 1936	Week ended June 1, 1935
New England States:								
Maine	0	1	10	13	0	0	1	2
New Hampshire	0	0	2	20	0	0	0	0
Vermont	0	0	6	4	0	0	0	0
Massachusetts	8	0	179	246	0	0	5	3
Rhode Island	0	0	23	15	0	0	0	1
Connecticut	0	0	17	96	0	0	2	2
Middle Atlantic States:								
New York	1	1	610	959	0	0	2	7
New Jersey	0	2	226	157	0	0	1	3
Pennsylvania	1	0	342	338	0	0	6	7
East North Central States:								
Ohio	0	0	210	560	0	0	5	7
Indiana	0	0	88	89	0	0	1	7
Illinois [2]	0	1	412	1,138	20	4	4	6
Michigan	0	1	287	268	0	0	2	5
Wisconsin	0	0	310	456	1	9	0	1
West North Central States:								
Minnesota	0	1	249	276	3	16	0	3
Iowa	1	1	154	68	42	3	0	0
Missouri	0	0	91	48	7	4	1	8
North Dakota	0	0	16	40	11	0	2	2
South Dakota	0	0	26	12	20	5	0	0
Nebraska	0	0	72	38	14	53	0	4
Kansas	0	0	154	39	9	22	0	7

See footnotes at end of table.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended May 30, 1936, and June 1, 1935—Continued

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended May 30, 1936	Week ended June 1, 1935	Week ended May 30, 1936	Week ended June 1, 1935	Week ended May 30, 1936	Week ended June 1, 1935	Week ended May 30, 1936	Week ended June 1, 1935
South Atlantic States:								
Delaware	0	0	1	6	0	0	0	0
Maryland [3]	0	0	38	76	0	0	0	4
District of Columbia	0	0	20	31	0	0	0	0
Virginia	0	2	45	20	0	0	15	12
West Virginia	1	1	40	58	0	0	5	6
North Carolina	2	25	18	14	1	0	7	5
South Carolina	0	1	4	1	0	0	2	16
Georgia [4]	0	1	10	2	0	0	7	3
Florida	0	1	4	4	0	0	0	2
East South Central States:								
Kentucky	0	0	17	24	0	0	6	3
Tennessee	1	0	10	18	3	0	3	11
Alabama [4]	0	2	2	7	0	0	4	7
Mississippi [3]	0	1	9	5	0	0	2	4
West South Central States:								
Arkansas	0	0	4	1	0	2	3	6
Louisiana	0	4	6	7	0	0	10	6
Oklahoma [3]	0	0	26	6	4	3	6	5
Texas [4]	0	0	50	28	13	24	7	10
Mountain States:								
Montana [3]	0	0	54	6	7	0	1	6
Idaho [3]	0	0	12	3	3	0	0	0
Wyoming [3]	0	0	23	8	33	5	0	0
Colorado [3]	0	0	51	172	2	3	1	0
New Mexico	1	0	35	9	0	1	1	3
Arizona	0	1	20	41	0	0	2	3
Utah [3] [5]	0	0	39	117	2	0	1	0
Pacific States:								
Washington	0	0	32	56	3	21	1	2
Oregon [3]	0	0	25	23	0	2	2	3
California	5	3	300	211	0	10	9	5
Total	21	50	4,379	5,834	198	187	127	197
First 22 weeks of year	402	565	160,216	155,197	5,032	4,168	2,582	3,108

[1] New York City only.
[2] Rocky Mountain spotted fever, week ended May 30, 1936, 13 cases, as follows: Illinois, 1; Montana, 5; Idaho, 2; Wyoming, 2; Colorado, 1; Utah, 1; Oregon, 1.
[3] Week ended earlier than Saturday.
[4] Typhus fever, week ended May 30, 1936, 16 cases, as follows: Georgia, 8; Alabama, 7; Texas, 1.
[5] Exclusive of Oklahoma City and Tulsa.

SUMMARY OF MONTHLY REPORTS FROM STATES

The following reports of cases reported monthly by States is published weekly and covers only those States from which reports are received during the current week.

State	Meningococcus meningitis	Diphtheria	Influenza	Malaria	Measles	Pellagra	Poliomyelitis	Scarlet fever	Smallpox	Typhoid fever
March 1936										
Puerto Rico	-------	56	3,276	982	38	3	0	-------	0	32
April 1936										
Missouri	26	88	3,803	47	115	-------	0	963	58	6
Montana	9	21	197	-------	53	-------	1	380	42	3
New York	91	170	-------	10	12,974	-------	4	4,292	0	32
North Dakota	1	5	38	-------	4	-------	0	195	34	4
Vermont	-------	4	-------	-------	2,786	-------	0	31	0	1
Virginia	43	55	1,189	9	568	17	2	212	2	13
Washington	8	3	69	-------	1,637	-------	1	388	47	6
Wisconsin	13	11	255	-------	510	-------	1	2,681	34	11

Summary of monthly reports from States—Continued

March 1936

	Cases
Puerto Rico:	
Chicken pox	69
Dysentery	19
Mumps	51
Ophthalmia neonatorum	6
Tetanus	18
Tetanus, infantile	3
Whooping cough	54

April 1936

	Cases
Chicken pox:	
Missouri	235
Montana	21
New York	2,348
North Dakota	38
Vermont	127
Virginia	246
Washington	344
Wisconsin	1,625
Conjunctivitis:	
Washington	2
Dysentery:	
New York (amoebic)	7
New York (bacillary)	14
Virginia (diarrhea included)	28
Washington (amoebic)	1
Washington (bacillary)	1
Epidemic encephalitis:	
Missouri	2
New York	11
Virginia	2

April 1936—Continued

	Cases
Epidemic encephalitis—Continued.	
Washington	2
Wisconsin	2
German measles:	
Montana	6
New York	989
Vermont	60
Washington	485
Wisconsin	194
Mumps:	
Missouri	656
Montana	366
North Dakota	114
Vermont	98
Virginia	362
Washington	400
Wisconsin	4,329
Ophthalmia neonatorum:	
New York [1]	10
Paratyphoid fever:	
New York	1
Rabies in animals:	
Missouri	9
New York [1]	10
Washington	5
Rocky Mountain spotted fever:	
Montana	18
Septic sore throat:	
Missouri	53
Montana	11
New York	65
Virginia	9

April 1936—Continued

	Cases
Septic sore throat—Con.	
Washington	5
Wisconsin	16
Tetanus:	
New York	2
Virginia	1
Trachoma:	
Missouri	58
Montana	9
North Dakota	2
Washington	1
Wisconsin	2
Trichinosis:	
New York	8
Typhus fever:	
New York	2
Undulant fever:	
Missouri	1
New York	16
Washington	6
Wisconsin	6
Vincent's infection:	
New York [1]	75
North Dakota	1
Whooping cough:	
Missouri	83
Montana	42
New York	944
North Dakota	4
Vermont	79
Virginia	137
Washington	173
Wisconsin	780

[1] Exclusive of New York City.

PLAGUE-INFECTED GROUND SQUIRRELS IN ELKO COUNTY, NEV.

Plague infection has been reported in ground squirrels, *Citellus elegans*, shot on May 7, 1936, on a sheep ranch located 8 miles northeast of Lamoille, Elko County, Nev. The infection was determined by inoculating guinea pigs with fleas taken from 50 ground squirrels. It was said that several hundred ground squirrels had previously been examined for plague in this region, but none had been found with suspicious lesions. (See p. 786 for a description of the method used.)

WEEKLY REPORTS FROM CITIES

City reports for week ended May 23, 1936

This table summarizes the reports received weekly from a selected list of 140 cities for the purpose of showing a cross-section of the current urban incidence of the communicable diseases listed in the table. Weekly reports are received from about 700 cities, from which the data are tabulated and filed for reference.

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Maine:											
Portland	0		0	213	2	1	0	0	0	5	22
New Hampshire:											
Concord	0		0	0	1	1	0	2	0	0	7
Nashua	0			47	0	1	0		0	0	
Vermont:											
Barre											
Burlington	0		0	66	0	0	0	0	0	0	8
Rutland	0		0	16	0	0	0	0	0	0	4
Massachusetts:											
Boston	4		1	332	16	51	0	10	1	30	226
Fall River	0		0	3	1	4	0	2	0	0	33
Springfield	0		0	1	1	3	0	3	0	1	36
Worcester	0		0	155	1	5	0	3	2	9	45
Rhode Island:											
Pawtucket	0		0	0	0	0	0	0	0	0	
Providence	0		0	25	2	18	0	3	0	2	67
Connecticut:											
Bridgeport	0		0	4	2	3	0	0	0	4	27
Hartford	0		0	1	7	3	0	2	0	1	71
New Haven	0	1	0	0	2	0	0	0	0	35	40
New York:											
Buffalo	0		0	75	19	56	0	8	0	7	146
New York	29		3	1,959	110	333	0	106	2	78	1,536
Rochester	0		0	7	3	3	0	2	0	0	64
Syracuse	0		0	113	5	10	0	2	0	10	45
New Jersey:											
Camden	1		0	10	2	4	0	1	0	0	33
Newark	0		0	13	8	60	0	9	0	29	108
Trenton	0		0	0	4	12	0	0	0	3	37
Pennsylvania:											
Philadelphia	5	1	1	563	33	73	0	27	0	61	487
Pittsburgh	2	3	2	18	40	126	0	5	0	35	180
Reading	0		0	26	6	1	0	0	0	1	25
Scranton	1			0		4	0		0	0	
Ohio:											
Cincinnati	1		0	14		26	0	1	0	2	101
Cleveland	3	6	0	151	12	51	0	10	1	121	179
Columbus	0		0	1	4	4	0	0	0	6	77
Toledo	1		0	32	7	3	0	3	0	27	82
Indiana:											
Anderson	0		1	0	0	8	0	0	0	0	10
Fort Wayne	0		0	0	3	9	0	0	0	0	27
Indianapolis	0		0	1	15	30	0	2	0	11	100
South Bend	0		0	0	2	2	0	1	0	2	12
Terre Haute	3		0	0	0	2	0	0	0	0	17
Illinois:											
Alton	1		0	0	0	11	0	0	0	3	7
Chicago	17		3	10	55	167	0	31	0	102	702
Elgin	0		0	1	2	1	0	0	0	1	13
Moline	1		0	0	1	3	0	0	0	1	8
Springfield	0		0	0	2	9	0	0	0	1	18
Michigan:											
Detroit	7	2	0	26	20	138	0	19	2	296	281
Flint	1		0	1	5	12	0	0	0	2	35
Grand Rapids	0		0	2	1	7	0	1	0	1	41
Wisconsin:											
Kenosha	0		0	1	1	3	0	0	0	0	9
Milwaukee	0	1	1	12	8	98	0	1	1	91	95
Racine	0		0	3	1	3	0	0	0	3	13
Superior	0		0	1	0	18	0	0	0	0	8
Minnesota:											
Duluth	0		0	7	3	20	0	1	0	10	27
Minneapolis	1		2	195	4	56	0	2	0	10	112
St. Paul	0		0	137	8	27	0	5	0	4	64
Iowa:											
Cedar Rapids	0			0		2	0		0	3	
Davenport	1			0		13	0		0	0	
Des Moines	0			2		16	10		0	0	29
Sioux City	0			0		9	31		0	2	
Waterloo	0			2		5	0		0	0	

City reports for week ended May 23, 1936—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Missouri:											
Kansas City	2	------	1	2	5	78	0	10	0	1	88
St. Joseph	------	------	------	------	------	------	------	------	------	------	------
St. Louis	9	------	3	4	7	54	0	13	0	9	192
North Dakota:											
Fargo	0	------	0	0	2	2	0	0	0	0	9
Grand Forks	0	------	------	0	------	0	0	------	0	0	------
Minot	0	------	0	2	0	23	0	0	0	0	5
South Dakota:											
Aberdeen	0	------	------	0	------	7	0	------	0	0	------
Nebraska:											
Omaha	0	------	0	13	3	30	2	0	0	0	47
Kansas:											
Lawrence	0	------	1	1	0	0	0	0	0	0	11
Topeka	------	------	------	------	------	------	------	------	------	------	------
Wichita	0	------	0	0	4	19	1	2	0	1	29
Delaware:											
Wilmington	0	------	0	2	1	1	0	0	0	7	23
Maryland:											
Baltimore	0	4	0	285	16	18	0	8	1	61	200
Cumberland	0	------	0	0	1	0	0	0	0	0	9
Frederick	0	------	0	0	1	1	0	0	0	0	3
District of Columbia:											
Washington	19	1	1	161	12	17	0	19	0	24	152
Virginia:											
Lynchburg	0	------	0	2	4	0	0	0	0	10	6
Norfolk	1	1	------	0	1	2	0	1	0	3	24
Richmond	1	------	1	2	6	18	0	1	2	0	43
Roanoke	0	------	0	0	1	0	0	1	0	0	15
West Virginia:											
Charleston	0	1	0	0	1	0	0	0	0	0	18
Huntington	0	------	0	0	0	0	0	0	0	0	------
Wheeling	0	------	0	42	2	3	0	1	1	4	14
North Carolina:											
Gastonia	0	------	0	0	1	0	0	0	0	0	7
Raleigh	------	------	------	------	------	------	------	------	------	------	------
Wilmington	0	------	0	0	0	0	0	1	0	0	11
Winston-Salem	0	1	0	15	1	0	0	0	0	0	16
South Carolina:											
Charleston	0	5	0	0	2	0	0	2	1	1	21
Columbia	0	------	0	0	0	0	0	0	0	0	4
Florence	0	------	0	0	0	0	0	0	0	0	------
Georgia:											
Atlanta	2	6	1	0	13	6	0	7	0	1	97
Brunswick	0	------	0	0	0	0	0	0	0	0	4
Savannah	0	1	1	0	0	0	0	1	1	0	26
Florida:											
Miami	0	1	0	16	1	0	0	2	0	20	23
Tampa	0	------	0	8	2	0	0	1	0	0	24
Kentucky:											
Ashland	0	------	0	0	0	0	0	0	0	1	4
Covington	0	------	0	2	0	0	0	4	0	0	18
Louisville	1	------	0	87	7	13	0	5	0	9	67
Tennessee:											
Knoxville	2	------	0	10	3	0	0	1	0	0	32
Memphis	0	------	0	0	5	6	0	5	0	16	98
Nashville	0	------	2	8	3	2	0	3	0	1	45
Alabama:											
Birmingham	0	2	0	3	8	0	0	4	0	0	60
Mobile	1	------	1	0	0	1	0	3	0	0	21
Montgomery	0	------	------	0	------	0	0	------	0	0	------
Arkansas:											
Fort Smith	0	------	------	0	------	2	0	------	2	0	------
Little Rock	0	------	1	1	3	1	0	1	0	0	5
Louisiana:											
Lake Charles	0	------	0	1	0	0	0	0	1	0	------
New Orleans	7	13	4	27	16	4	0	14	1	85	152
Shreveport	0	------	0	7	2	0	0	1	0	0	40
Oklahoma:											
Oklahoma City	2	10	1	2	4	11	0	0	0	2	45
Tulsa	0	------	------	1	------	3	0	------	0	3	------
Texas:											
Dallas	2	2	2	85	4	0	0	5	0	4	75
Fort Worth	1	------	0	1	1	2	0	3	0	0	34
Galveston	0	------	0	4	1	1	0	2	0	0	12
Houston	4	------	1	1	10	3	0	6	1	0	72
San Antonio	2	------	2	8	9	0	0	8	1	0	97

City reports for week ended May 23, 1936—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Montana:											
Billings	1	------	0	0	2	3	0	0	0	0	5
Great Falls	0	------	0	0	5	6	1	0	0	4	10
Helena	0	------	0	0	0	1	1	0	0	0	3
Missoula	0	------	0	0	0	7	0	0	0	0	3
Idaho:											
Boise	0	------	0	3	0	1	0	0	0	0	7
Colorado:											
Colorado Springs	0	------	0	1	2	8	0	0	0	0	10
Denver	3	------	0	35	9	18	0	3	2	34	84
Pueblo	0	------	0	0	0	15	0	1	0	1	10
New Mexico:											
Albuquerque	1	1	0	9	1	16	0	0	0	1	7
Utah:											
Salt Lake City	0	------	0	20	4	26	2	1	0	14	36
Nevada:											
Reno	------	------	------	------	------	------	------	------	------	------	------
Washington:											
Seattle	0	------	1	210	9	3	1	4	0	6	86
Spokane	0	------	0	9	2	18	0	0	0	8	35
Tacoma	0	------	0	23	1	4	0	0	0	3	30
Oregon:											
Portland	0	------	0	4	6	5	0	1	0	13	53
Salem	0	3	------	9	------	0	1	------	0	0	------
California:											
Los Angeles	8	13	1	281	12	34	0	25	1	59	300
Sacramento	1	------	0	2	0	9	0	2	1	15	26
San Francisco	2	------	0	145	8	70	0	10	0	39	163

State and city	Meningococcus meningitis		Poliomyelitis cases
	Cases	Deaths	
Massachusetts:			
Boston	3	3	3
New York:			
Buffalo	0	1	0
New York	15	5	0
New Jersey:			
Newark	0	2	0
Pennsylvania:			
Philadelphia	2	0	0
Ohio:			
Cincinnati	3	0	0
Cleveland	1	0	0
Toledo	1	1	0
Indiana:			
Indianapolis	2	0	0
Illinois:			
Chicago	6	2	0
Michigan:			
Detroit	1	0	0
Minnesota:			
Minneapolis	2	1	0
Iowa:			
Des Moines	0	0	1
Missouri:			
St. Louis	1	0	0
Maryland:			
Baltimore	3	0	0
District of Columbia:			
Washington	4	2	0
Virginia:			
Lynchburg	1	0	0
Richmond	0	1	0
West Virginia:			
Huntington	1	0	0
Wheeling	1	0	0
Georgia:			
Atlanta	1	2	0
Savannah	1	0	0
Kentucky:			
Ashland	0	1	0
Louisville	0	1	0
Tennessee:			
Knoxville	0	1	0
Memphis	1	0	0
Louisiana:			
New Orleans	1	0	0
Oklahoma:			
Oklahoma City	1	0	0
Texas:			
Dallas	1	0	0
California:			
Los Angeles	3	2	2

Epidemic encephalitis.—Cases: Pittsburgh, 1; Charleston, S. C., 1.
Pellagra.—Cases: Winston-Salem, 4; Charleston, S. C., 1; Savannah, 1; Louisville, 1; Birmingham, 1; Dallas, 1; Los Angeles, 1.
Typhus fever.—Cases: Montgomery, 1.

FOREIGN AND INSULAR

CANADA

Provinces—Communicable diseases—2 weeks ended May 16, 1936.—During the 2 weeks ended May 16, 1936, cases of certain communicable diseases were reported by the Department of Pensions and National Health of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Cerebrospinal meningitis				3	2		1		2	8
Chicken pox		5	9	160	334	43	44	31	125	751
Diphtheria		6	3	43	7	3	5	1		68
Dysentery					1					1
Erysipelas		1		12	3	5	7	2	6	36
Influenza		13	2		15		22		58	110
Measles		26	24	1,099	3,531	406	587	201	1,437	7,311
Mumps		1			759	98	118	24	165	1,165
Paratyphoid fever					1					1
Pneumonia		6			27		3		11	47
Poliomyelitis						1	1			2
Scarlet fever		35	5	191	275	113	24	54	33	730
Smallpox								5		5
Trachoma							2			2
Tuberculosis	12	5	33	173	135	13	27		24	422
Typhoid fever		1	1	25	3			1		31
Undulant fever					9	1				10
Whooping cough		7	1	63	302	9	60	3	81	526

DENMARK

Communicable diseases—January—March 1936.—During the months of January, February, and March 1936, certain communicable diseases were reported in Denmark as follows:

Disease	January	February	March	Disease	January	February	March
Cerebrospinal meningitis	4	9	3	Paradysentery	11	52	44
Chicken pox	92	114	159	Paratyphoid fever	6	2	5
Diphtheria and croup	333	285	276	Poliomyelitis	5	4	3
Epidemic encephalitis	2	1	2	Puerperal fever	18	13	26
Erysipelas	299	245	261	Scabies	1,361	878	969
German measles	60	225	703	Scarlet fever	734	564	624
Gonorrhea	1,003	672	817	Syphilis	86	70	62
Influenza	8,476	7,204	11,259	Tetanus, neonatorum	3	1	5
Malaria	7	3	4	Typhoid fever	4	3	3
Measles	1,072	545	523	Undulant fever (Bact. abort. Bang)	44	32	54
Mumps	1,013	848	1,074	Whooping cough	3,691	2,980	3,057

FRANCE

Vital statistics—1935–1934—Comparative.—Following are vital statistics for France for the years 1935 and 1934:

	1935	1934		1935	1934
Number of marriages	284,604	298,192	Total deaths	658,357	634,525
Live births	638,881	677,365	Deaths per 10,000 population	157	151
Live births per 10,000 population	152	161	Deaths under 1 year of age	44,267	46,989
Stillbirths	24,055	25,722	Deaths under 1 year per 1,000 live births	69	69

JAMAICA

Communicable diseases—4 weeks ended May 16, 1936.—During the 4 weeks ended May 16, 1936, cases of certain communicable diseases were reported in Kingston, Jamaica, and in the island outside of Kingston, as follows:

Disease	Kingston	Other localities	Disease	Kingston	Other localities
Chicken pox		9	Puerperal fever	1	1
Dysentery	9	8	Tuberculosis	56	86
Leprosy	2	2	Typhoid fever	16	51

YUGOSLAVIA

Communicable diseases—April 1936.—During the month of April 1936, certain communicable diseases were reported in Yugoslavia as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Anthrax	28	3	Paratyphoid fever	12	2
Cerebrospinal meningitis	18	6	Scarlet fever	369	8
Diphtheria and croup	499	47	Sepsis	14	4
Dysentery	15	1	Tetanus	36	12
Erysipelas	234	7	Typhoid fever	227	43
Influenza	87	2	Typhus fever	106	9
Measles	1,250	23			

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER

NOTE.—A table giving current information of the world prevalence of quarantinable diseases appeared in the PUBLIC HEALTH REPORTS for May 29, 1936, pages 718–730. A similar cumulative table will appear in the PUBLIC HEALTH REPORTS to be issued June 26, 1936, and thereafter, at least for the time being, in the issue published on the last Friday of each month.

Plague

Brazil—Ceara State—Crato.—During the week ended April 4, 1936, 1 case of plague was reported at Crato, Ceara State, Brazil.

Smallpox

Mexico.—During the month of March, smallpox was reported in Mexico as follows: Aguascalientes, Aguascalientes State, 4 cases, 2 deaths; Chihuahua, Chihuahua State, 1 case, 1 death; Colima State, 1 case; Guanajuato State, 5 cases, 3 deaths; Guadalajara, Jalisco State, 70 cases, 43 deaths; Mexico State, 4 cases, 1 death; Mexico, D. F., 18 cases, 2 deaths; Morelos State, 1 case; Puebla, Puebla State, 2 cases, 1 death; San Luis Potosi, San Luis Potosi State, 8 cases, 2 deaths; Sonora State, 1 case; Tlaxcala State, 1 death; Quintana Roo, 1 case.

Typhus Fever

Bolivia.—During the month of April 1936, 75 cases of typhus fever were reported in Bolivia as follows: La Paz Department, 18 cases; Oruro Department, 5 cases; Potosi Department, 52 cases.

China—Shanghai.—During the week ended May 2, 1936, 1 case of typhus fever was reported at Shanghai, China.

Mexico.—During the month of March 1936, typhus fever was reported in Mexico as follows: Aguascalientes, Aguascalientes State, 5 cases, 1 death; Durango State, 1 case, 1 death; Guanajuato State, 56 cases, 18 deaths; Leon, 20 cases, 7 deaths; Mexico State, 15 cases, 1 death; Mexico, D. F., 52 cases, 22 deaths; Puebla, Puebla State, 3 cases; San Luis Potosi, San Luis Potosi State, 6 cases; Tlaxcala State, 1 case.

Yellow Fever

Bolivia—Santa Cruz Department.—During the month of April 1936, 1 case of yellow fever was reported in Santa Cruz Department, Bolivia.